

## CLAIMS

1. An acoustic mirror type thin film bulk acoustic resonator comprising:

5 a substrate;

an acoustic mirror layer provided on the substrate, including a plurality of impedance layers alternately having a high acoustic impedance and a low acoustic impedance; and

10 a piezoelectric thin film vibrator provided on the acoustic mirror layer, including a lower electrode, a piezoelectric thin film and an upper electrode,

wherein the sum of a thickness of the lower electrode and a thickness of the upper electrode is 5% or more and 60% or less of a whole thickness of the piezoelectric thin film vibrator, and  
15 the thickness of the lower electrode is larger than the thickness of the upper electrode.

2. The thin film bulk acoustic resonator according to claim 1, wherein the plurality of impedance layers includes a  
20 plurality of low acoustic impedance layers and a plurality of high acoustic impedance layers which are alternately disposed, and an uppermost one of the low acoustic impedance layers which contacts the lower electrode, has a thickness of one fourth of an acoustic wavelength defined from a resonant frequency in free  
25 space of the piezoelectric thin film vibrator.

3. The thin film bulk acoustic resonator according to  
claim 2, wherein each of the plurality of low acoustic impedance  
layers has a thickness of one fourth of the acoustic wavelength  
5 defined from the resonant frequency in free space of the  
piezoelectric thin film vibrator.

4. The thin film bulk acoustic resonator according to  
claim 1, wherein the plurality of impedance layers includes a  
10 plurality of low acoustic impedance layers and a plurality of high  
acoustic impedance layers which are alternately disposed, and  
an uppermost one of the low acoustic impedance layers which  
contacts the lower electrode, has a thickness of less than one  
fourth of an acoustic wavelength defined from a resonant frequency  
15 in free space of the piezoelectric thin film vibrator.

5. The thin film bulk acoustic resonator according to  
claim 4, wherein each of the plurality of low acoustic impedance  
layers has a thickness of less than one fourth of the acoustic  
20 wavelength defined from the resonant frequency in free space of  
the piezoelectric thin film vibrator.

6. The thin film bulk acoustic resonator according to  
claim 1, wherein the plurality of impedance layers includes a  
25 plurality of low acoustic impedance layers and a plurality of high

acoustic impedance layers which are alternately disposed, and  
an uppermost one of the low acoustic impedance layers which  
contacts the lower electrode, has a thickness of more than one  
fourth of an acoustic wavelength defined from a resonant frequency  
5 in free space of the piezoelectric thin film vibrator.

7. The thin film bulk acoustic resonator according to  
claim 6, wherein each of the plurality of low acoustic impedance  
layers has a thickness of more than one fourth of the acoustic  
10 wavelength defined from the resonant frequency in free space of  
the piezoelectric thin film vibrator.

8. The thin film bulk acoustic resonator according to  
claim 1, wherein the plurality of impedance layers includes a  
15 plurality of low acoustic impedance layers and a plurality of high  
acoustic impedance layers which are alternately disposed, and  
at least an uppermost one of the plurality of low acoustic  
impedance layer, has a thickness different from one fourth of an  
acoustic wavelength defined from a resonant frequency in free space  
20 of the piezoelectric thin film vibrator, and  
an uppermost one of the high acoustic impedance layers has  
a thickness different from one fourth of the acoustic wavelength  
defined from the resonant frequency in free space of the  
piezoelectric thin film vibrator.

9. The thin film bulk acoustic resonator according to  
claim 8, wherein each of the plurality of high acoustic impedance  
layers has a thickness different from one fourth of the acoustic  
wavelength defined from the resonant frequency in free space of  
5 the piezoelectric thin film vibrator.

10. A filter comprising two or more thin film bulk acoustic  
resonators which are connected in a ladder form, wherein  
at least one of the thin film bulk acoustic resonators  
10 comprises:

a substrate;  
an acoustic mirror layer provided on the substrate,  
including a plurality of impedance layers alternately having a  
high acoustic impedance and a low acoustic impedance; and  
15 a piezoelectric thin film vibrator provided on the  
acoustic mirror layer, including a lower electrode, a piezoelectric  
thin film and an upper electrode,

wherein the sum of a thickness of the lower electrode  
and a thickness of the upper electrode is 5% or more and 60% or  
20 less of a whole thickness of the piezoelectric thin film vibrator,  
and the thickness of the lower electrode is larger than the thickness  
of the upper electrode.

11. A duplexer comprising a transmission filter and a  
25 reception filter, wherein

at least one of the transmission filter and the reception filter comprises two or more thin film bulk acoustic resonators which are connected in a ladder form, and

5 at least one of the thin film bulk acoustic resonators comprises:

a substrate;

an acoustic mirror layer provided on the substrate, including a plurality of impedance layers alternately having a high acoustic impedance and a low acoustic impedance; and

10 a piezoelectric thin film vibrator provided on the acoustic mirror layer, including a lower electrode, a piezoelectric thin film and an upper electrode,

wherein the sum of a thickness of the lower electrode and a thickness of the upper electrode is 5% or more and 60% or 15 less of a whole thickness of the piezoelectric thin film vibrator, and the thickness of the lower electrode is larger than the thickness of the upper electrode.

12. A communication apparatus comprising at least one thin 20 film bulk acoustic resonator, wherein

the at least one thin film bulk acoustic resonators comprises:

a substrate;

an acoustic mirror layer provided on the substrate, 25 including a plurality of impedance layers alternately having a

high acoustic impedance and a low acoustic impedance; and  
a piezoelectric thin film vibrator provided on the  
acoustic mirror layer, including a lower electrode, a piezoelectric  
thin film and an upper electrode,

5 wherein the sum of a thickness of the lower electrode  
and a thickness of the upper electrode is 5% or more and 60% or  
less of a whole thickness of the piezoelectric thin film vibrator,  
and the thickness of the lower electrode is larger than the thickness  
of the upper electrode.